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The Baylor College of Medicine Summer Science Institute Effect on HISD Elementary- and Middle-School Students' Science Performance, 2014–2015

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The purpose of this study was to measure the effect of the Baylor College of Medicine Summer Science Institute (BCMSSI) on teacher science content knowledge and students' science performance. The analysis of the effect of participation showed an increase of 253 scale score points on the 2015 STAAR science performance of eighth-grade students whose teachers completed all 60 professional development (PD) hours. A higher proportion of 5th- and 8th-grade students whose teachers completed the full PD hours met Satisfactory at the Level II phase-in 1 standard and Advanced performance standard on the 2015 STAAR science test compared to their peers whose teachers did not complete the full PD hours. The results also showed statistically significant moderate to large gains in teacher content knowledge and self-efficacy at all grade levels. Teachers at all grade levels were also, overwhelmingly, positive about the science institute and agreed that the resources and materials that they received were useful. Increasing the number of teachers who complete the BCMSSI program should be considered. Continued instructional focus should be placed on improving the science performance of at-risk and economically-disadvantaged students.

Background

The BCM Summer Science Institute (BCMSSI) is a professional development program that offers current and effective teaching strategies, in-depth science content lessons, assessment, and relevant science concepts that are aligned with the Texas Essential Knowledge and Skills (TEKS) and the State of Texas Assessments of Academic Readiness (STAAR) recommended learning objectives (BCM, 2013). This program targeted the Houston Independent School District (HISD) prekindergarten to eighth-grade teachers who taught science in self-contained classes, science labs, and regular education classes. The Institute included presentations by scientists and the use of inquiry-based, grade-appropriate science lessons. Hands-on lessons and activities with online lessons were available for workshop participants and other teachers.

New BCMSSI participants attended a two-week workshop. Returning elementary- and middle-school teachers attended a one-week workshop. In addition, teachers were encouraged to attend five follow-up workshop sessions throughout the academic year. The program culminated with a science festival in which participants displayed skills and content learned.

Baylor College of Medicine was the contracted service provider. The contract was financed under the Teacher Incentive Fund (TIF) grant in the amount of $285,000. In addition, the cost of the follow-up workshops, which amounted to $77,054, was met under Title 2 funds. Teachers were compensated using TIF 3, TIF 4, and general funds for their BCMSSI participation.

Literature Review

Participation in summer science institutes have increased the number of teachers providing opportunities for their students to conduct full scientific inquiry using deep science content and process knowledge with numerous opportunities for practice (Jeanpiere, Oberhauser & Freeman, 2005). Where teachers examined student thinking and their implications for instruction, students' and teachers'

science content knowledge and test scores increased (Heller, Dahler, Wong, Shinohara & Miratrix, 2012).

Research has shown that teachers who demonstrated improvements in science content knowledge and their abilities to analyze science teaching also demonstrated higher gains in students' science content knowledge (Roth, Garnier, Chen, Lemmens, Schwille, & Wickler, 2011). The improvement in students' science content knowledge was also associated with teachers' pedagogical content knowledge about students' thinking, and teaching practices aimed at improving the coherence of science content storylines (Roth, et al., 2011).

Third- and fourth-grade culturally and linguistically diverse students whose teachers had a yearlong science professional development program demonstrated significant growth in the inquiry abilities of all students. Low achieving, low-SES, and LEP students made impressive gains (Cueras, Lee, Hart, & Deaktor, 2005). A three-year professional development program to improve teaching practice significantly raised third- to fifth-grade science scores. It consistently decreased the achievement gaps among third- and fifth-grade demographic groups but held steady for the fourth grade (Luft, Wong & Ortega, 2009).

A study designed to measure the influence of inquiry science on teacher practices among fourth- and fifth-grade teachers in the Los Angeles United School District found that there was increased incidence of inquiry-based science teaching. The impacts, however, were limited to selected features of the inquiry process to which the teachers were most frequently exposed during the professional development (Griggs, Kelly & Geoffrey, 2013).

Elementary teachers exposed to long-term professional development programs demonstrated increased content knowledge (Lumpe, Czerniak, Haney & Beltyukova, 2012). Teachers in the four-year Rice Elementary Model Science Lab (REMSL) increased their scientific content knowledge in all four years. In the last two years of the program, their gains in science content knowledge, use of inquiry based instruction, and leadership skills were significantly higher than that of the control group participants (Deaconu, Juskavceric, & Nichol, 2012). Students' science process skills and their content and concept knowledge were assessed after their teacher's participation in an elementary STEM professional development program. Results showed gains in science process skills, science concepts and content knowledge among the general education students. Teacher participation in the program had statistically significant effects on student posttest science scores (Cotabish, Dailey, Ann & Hughes, 2013).

The 2013 and 2014 evaluation of the BCMSSI's impact on elementary and middle school students' science performance found statistically significant increases in the Stanford 10 fifth-grade science in the 2013 sample and the third and fourth grades in 2014. Similar increases occurred at the seventh and eighth grades in 2013 and the eighth grade in 2014 among students whose teachers participated in the BCMSSI program (Holmes, 2013; Serrant, 2014). Linear regression modeling indicated that the follow-up or additional hours of professional development was the strongest predictor of students' science performance in 2013 (Holmes, 2013) while students' previous science score was the strongest predictor of their science performance in 2014 (Serrant, 2014).

The purpose of this evaluation is to measure changes in BCMSSI teachers' content knowledge and determine the BCMSSI effect on the science performance of elementary and middle students whose teachers participated in the Institute's training activities. Specifically, the study sought to answer three questions:

1. How did participation in the 2014 BCMSSI impact teachers' science content-knowledge?
2. How did students whose teachers participated in the 2014 BCMSSI perform on the 2015 science assessments?
3. What was the effect of the 2014 BCM Summer PD hours on students' STAAR science performance?

Methodology

Data Analysis

This study involved students whose teachers participated in the 2014 summer institute. Only new teacher participants were included in the study to control for multiple treatment effects. Elementary teacher participants were exposed to 60 hours of the summer institute's PD activities, while middle school teachers received a maximum of 30 PD hours. Teachers were compensated for participation in the Institute based on attendance. Professional development hours were categorized for analysis based on the U.S. Department of Education Institute of Education Sciences' What Works Clearinghouse (WWC) research on teacher professional development. Specifically, Elementary PD hours were categorized as 1–48.9; 49–59.9, and 60 hours. Middle schools were categorized as 1–29, and 30 hours. WWC research showed that at least 49 hours of professional development resulted in 21% increase in student achievement in reading, mathematics, science, and social studies (Yoon, Duncan, Lee, Scarloss & Shapley, 2009).

Treatment Effect

The treatment effects regression adjustment (teffects ra) in STATA 13 was used to estimate the effects of the BCMSSI PD hours on the STAAR science performance of 5th- and 8th-grade students whose teachers completed the full 60 PD hours for elementary schools and 30 PD hours for middle schools. Fifth and eighth grades were selected for student participants because teacher pre-post PD tests and students' STAAR tests were linked to the TEKS. In addition, STAAR science tests are offered in the 5th and 8th grade only. The regression adjustment estimate predicts potential outcomes adjusted for covariates assuming that the outcome determinants are known. It uses differences in averages of treatment-specific predicted outcomes to estimate treatment effects (Cameron & Trivedi, 2005). This study used students' economic, at-risk, special education, limited English proficiency, and gifted and talented identification statuses as the outcome adjustment covariates. The treatment group constituted teachers who completed the full 60 or 30 BCMSSI PD hours for elementary and middle schools, respectively. Teachers who did not complete the full PD hours were the comparison group.

Linear Regression Analysis

Summer PD hours and students' economic, at risk and G/T statuses were analyzed to determine how these factors contributed to the variability in students' science scores and, therefore, predict their science performance. Collinearity tests were conducted in the selection of the variables. The follow-up hours were not included as few teachers completed them resulting in small sample sizes when they were disaggregated by grade.

Sample

A total of 239 first- through eighth-grade elementary and middle school teachers enrolled as participants in the 2014 BCMSSI. Of these, 61 (25.5%) were repeat participants. About 48.5% (116 elementary teachers) participated in the 60 hours summer sessions. Additionally, 62 (25.9%) middle school teachers enrolled in the 30-hour summer sessions.

Only 58 (24.3%) teachers participated in the 20 hours of Saturday follow-up sessions. New teachers in the study were linked to their 2014–2015 science students. **Table 1** displays the demographic composition by grade for these students. The State of Texas Assessments of Academic Readiness (STAAR) and Iowa Assessments science test data were used to measure students' performance, including the STAAR scale score, the proportion of students who met Satisfactory performance at the level II phase-in 1 and Advanced standard, along with the Iowa Assessments Normal Curve Equivalent (NCE) and National Percentile Rank (NPR). The data satisfied the tests for normality, homoscedasticity, and collinearity conditions using the Shaphiro-Wilk test, the normal Q-Q plot, and the Detrended normal Q-Q plot on the IBM Statistical Package for Social Sciences (SPSS) software.

Table 1. Selected Students' Demographic Characteristics By Grade, HISD, 2015

	Grade Level							
	First	***Second***	***Third***	***Fourth***	***Fifth***	***Sixth***	***Seventh***	***Eighth***
Total students (n)	**814**	**779**	**1,037**	**1,401**	**2,534**	**2,494**	**3,218**	**2,285**
	%	***%***	***%***	***%***	***%***	***%***	***%***	***%***
Asian	8.0	9.3	7.3	3.6	4.2	3.9	4.4	4.8
Black	35.3	35.3	25.6	33.0	26.7	26.7	26.6	30.0
Hispanic	43.4	40.6	55.8	59.6	63.5	57.7	57.2	53.5
White	11.3	12.9	9.7	3.0	5.0	10.4	10.4	10.4
Non-At-Risk	33.6	40.5	32.4	37.2	40.9	38.6	49.2	39.2
At-Risk	66.4	59.5	67.6	62.8	59.1	61.4	50.8	60.8
Non-Special Ed.	96.0	95.5	93.9	93.0	93.2	91.6	92.2	93.1
Special Ed.	4.0	4.5	6.1	7.0	6.8	8.4	7.8	6.9
Non-G/T	83.1	78.0	76.0	83.6	75.3	83.4	75.4	75.6
G/T	16.9	22.0	24.0	16.4	24.7	16.6	24.6	24.4
Non-Economically Disadv.	30.6	30.1	28.9	17.3	18.5	26.7	32.1	32.3
Economically Disadv.	69.4	69.9	71.1	82.7	81.5	73.3	67.9	67.7

Note: These are students whose teachers were new participants in the 2014 BCMSSI

How did participation in the 2014 BCMSSI impact teachers' science content knowledge?

Gains in the science content knowledge of the 2014 BCMSSI teacher participants were assessed on four multiple-choice tests: introductory elementary, sixth grade, seventh grade, and eighth grade. Tests were linked to the grade-level science TEKS and validated using Cronbach's alpha (α) (Baylor College of Medicine, 2015). Cronbach's α measures the internal consistency of test items to determine how related they are as a group (Tavakol & Dennick, 2011). The higher the Cronbach's α, the closer the relatedness and the more valid the test will be. With respect to the four tests, their Cronbach's α ranged from 0.39 to 0.68 (Baylor College of Medicine, 2015).

Science content knowledge tests were first administered during the first PD session and again on the final day and the results reported as the mean number of items correct by grade. The results were analyzed using a repeated measures design. **Table 2** shows the mean changes and the PD effect on teacher content knowledge using Cohen's *d*. With the exception of 8th grade, all teachers demonstrated significant gains in their mean science content knowledge, which ranged from a mean difference of 0.44 items correct in the 8th grade to 7.53 items correct in the 3rd grade.

Table 2. BCMSSI teacher content knowledge assessment by grade

Grade	n	Pretest		Posttest		Gain	Cohen's d
		Mean	SD	Mean	SD		
1st	21	12.57	3.46	14.57	2.87	2.00*	0.64
2nd	22	11.96	3.33	16.50	3.71	4.54*	1.32
3rd	15	13.67	2.66	21.20	2.73	7.53*	2.89
4th	14	13.36	3.86	16.86	2.93	3.50*	1.06
5th	43	14.51	4.10	18.05	4.71	3.54*	0.81
6th	13	23.08	3.43	27.39	1.89	4.31*	1.62
7th	21	19.95	2.36	22.43	2.25	2.48*	1.10
8th	25	20.40	2.14	20.84	6.46	0.44	0.09

Note: *p < .05
Cohen's d: small = .20; medium = .50; and large = .80
Source: Baylor College of Medicine, 2015 (data only)

Third-grade teachers in the sample registered the highest mean science content knowledge gain followed by 2nd- and 6th-grade teachers. With the exception of the 8th grade, the effect sizes of the BCMSSI on teacher science content knowledge gain ranged from moderate to very large, (Cohen's d) that is, from 0.09 in the 8th grade to 2.89 in the 3rd grade.

BCMSSI service provider also measured pre-post science teacher self-efficacy using the Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST). The result showed statistically significant gains in self-efficacy on teachers' personal beliefs about their effectiveness in teaching science and their pedagogical content knowledge at all grade levels in the study (Baylor College of Medicine, 2015).

Baylor College of Medicine (2015) also administered a post-intervention survey to evaluate teacher perceptions and experiences with key program aspects. Teacher respondents at the respective grade levels were "overwhelmingly positive about the Science Institute. They agreed or strongly agreed that the activities were well organized and that the materials and resources received were useful" (p.18).

How did the students whose teachers participated in the 2014 BCM Summer Institute perform on the 2015 science assessments?

Iowa Science

The BCMSSI students' elementary science performance on the Iowa Assessments ranged from a mean NCE of 46.2 (SD = 20.5) in the 4th grade to 56.4 (SD = 22.5) in the 2nd grade (**Table 3**). BCMSSI third-grade students had a mean NCE of 54.0 (SD = 20.0) while first grade had a mean NCE of 47.0 (SD = 25.3).

Table 3. Elementary students' 2015 Iowa Assessments science performance on the 2014 BCMSSI teachers

Grade	*n*	*Mean NCE*	*SD*
1st	814	47.0	25.3
2nd	779	56.4	22.5
3rd	1,037	54.0	20.0
4th	1,398	46.2	20.5
5th	2,529	50.7	19.7

At the middle school level, BCMSSI students' science performance ranged from 45.0 NCEs (SD = 22.2) in the 6th grade to 49.4 (SD = 20.8) in the 7th grade (**Table 4**). The 8th-grade students had a mean NCE of 48.7 (SD = 21.8).

Table 4. Middle school students' 2015 Iowa Assessment science performance for 2014 BCMSSI teachers

Grade	*n*	*Mean NCE*	*SD*
6th	2,493	45.0	22.2
7th	3,218	49.4	20.8
8th	2,285	48.7	21.8

Table 5 shows that with the exception of 5th-grade, all BCMSSI teachers were exposed to at least 49 PD hours. The 3rd-grade had the highest proportion of BCMSSI students (63.9 percent) who scored at or above the 50th NPR on the Iowa science assessments, followed by students in the 2nd grade (63.2 percent). BCMSSI teachers of students in these two grade levels completed between 49 and 60 PD hours. These teachers

also had the largest content knowledge gain (See Table 2).

Table 5. Percent of students of BCMSSI teachers who performed at or above the 50th NPR on the 2015 Iowa science assessments by teachers' Summer PD Hours

		Summer PD Hours		
Grade	***n***	**1–48.9**	**49–59.9**	**60**
1st	406	-	53.1	31.5
2nd	383	-	63.2	53.6
3rd	588	-	63.9	57.1
4th	620	-	47.7	36.0
5th	1,955	40.0	48.4	58.3

A higher proportion of 1st through 4th-grade students whose teachers completed 49–59.9 BCMSSI hours performed at or above the 50th NPR on the Iowa science assessments compared to those whose teachers completed all 60 PD hours. While it is uncertain why this is the case here, data from the WWC indicates significant effect in student's achievement for at least 49 PD hours. For teachers who completed all 60 BCMSS PD hours, 5th-grade had the highest proportion of students (58.3%) who performed at or above the 50th NPR, followed by 3rd grade (57.1 %) and 2nd-grade (53.6 %). For teachers who completed all 60 BCMSSI PD hours, the 1st and 4th grades had the smallest proportion of students who performed at or above the 50th NPR at 31.5% and 36.0%, respectively.

A higher proportion of middle school students whose BCMSSI teachers completed all 30 PD hours (a range of 48.2% to 53.1%) performed at or above the 50th NPR on the Iowa science assessments compared to students whose teacher completed less hours (a range of 34.6% to 47.4%) (**Table 6**). Eighth-grade students whose BCMSSI teachers completed the full 30 PD hours had the highest proportion of students performing at or above the 50th NPR (53.1%), followed by 7th grade at 50.0%.

Table 6. Percent students who performed at or above the 50th NPR on the 2015 Iowa science assessment of 2014 BCMSSI teachers

		Summer PD Hours	
Grade	**n**	**18 -29**	**30**
6th	2,493	34.6	48.2
7th	3,218	47.4	50.0
8th	2,285	40.9	53.1

STAAR Science

With respect to the 2015 STAAR science test, fifth-grade students whose BCMSSI teachers completed the full 60 PD hours had the highest mean scale score (3711) as well as the highest percentage of students who met Satisfactory at the Level II phase-in 1 standard (67.1 percent), followed by students whose teachers completed 48.9 BCMSSI PD hours or less. These students had a mean scale score of 3615 with 58.1% of them who met Satisfactory at the Level II phase-in 1 standard for science (**Table 7, Appendix A,** p. 8).

A higher proportion of 5th-grade students whose teachers completed the full 60 BCMSSI PD hours (9.9%) met the Advanced performance standard on the STAAR science test compared to those who completed 49–59.9 hours (6.6 %) and those who completed 48.9 hour or less (5.4 %) (Table 7, Appendix A, p. 8).

Eighth-grade students whose BCMSSI teachers completed the full 30 PD hours had a higher mean scale score (3659) compared to students whose teacher completed less than 30 PD hours (3390) (Table 8, Appendix A, p. 8). A higher proportion of 8th-grade students whose teacher completed the full 30 BCMSSI PD hours (64.8%) met Satisfactory at the Level II phase-in 1 standard on the STAAR science test compared to those whose teachers completed less than 30 PD hours (45.6%), a difference of 19.2 percentage points. More than three times as many 8th-grade students whose teachers completed the full 30 PD hours met Advanced performance standard (17.7%) on the 2015 STAAR science test compared to students whose teachers completed less than 30 hours (5.0 percent).

Although 8th-grade students whose teachers completed the full 30 hours PD had a mean scale score that was lower than the district mean (3659 vs. 3721), a higher proportion of those students met Satisfactory at the level II phase-in 1 (64.8% vs. 61.0%). and Advanced performance standards (17.7% vs. 14.0%) on the 2015 STAAR science test compared to the district.

What was the effect of the 2014 BCM Summer PD hours on students' 2015 STAAR science performance?

Treatment effects regression adjustment showed the effects of 60 summer PD hours of 5th-grade and 30 PD hours on the 8th–grade students' STAAR science performance. The results revealed a significant increase of 253 scale score points in the mean scale score of the 8th-grade students whose BCMSSI teachers were exposed to the full 30 PD hours (**Table 9**, Appendix A, p. 8). The mean scale score for those who were not exposed to the full 30 hours (potential outcome mean) was 3365 scale score points. Table 2 shows that the gain in the 8th grade BCMSSI teachers' content knowledge was small (Cohen's d = 0.09) but their content knowledge appeared to have been high to begin with (20.40), second only to 6th-grade teachers (23.08). This may help to explain the large effect size.

The treatment effect of the BCMSSI 60 PD hours on the 5th-grade science performance was small (17 scale

score points) and statistically insignificant ($p > .524$) (**Table 10**, Appendix A, p. 9). The potential outcome mean using STATA teffects ra, indicated that for students whose teachers were not exposed to the full 60 PD hours their expected scale score was 3589 (Table 10, Appendix A, p. 9).

Based on regression analysis results, the summer PD hours were responsible for small variations in the Iowa Assessment science NCE for 1st through 8th grade. The variations were significant at the $p < .0001$ level for 2nd, and 6th through 8th grades (**Table 11** and **Table 12**, Appendix A, p. 9). Too few teachers completed the follow-up sessions to conduct any meaningful data analyses.

Students' at-risk and economically-disadvantaged statuses were negative predictors of the 2015 STAAR science mean scale score at the 1st- through 8th-grade levels for BCMSSI students. Students' at-risk status (the largest prediction of the two) predicted between 27.2% and 44.1% of variations in the science NCE for all grades in the study. G/T identification was a positive predictor at all grade levels in the study, predicting between 24.3% and 34.3% variations in the BCMSSI teacher' students mean NCE (Table 11 and Table 12).

Discussion

Results of this evaluation showed that teacher content knowledge increased for all teacher groups in the study, ranging from mean difference of 0.44 items correct in the 8th-grade to 7.53 items correct in the 3rd grade. The PD effect, using Cohen's *d*, was moderate or large for all groups except 8th-grade but 8th-grade teacher content knowledge was high to begin with. Cohen's d is a measure of the effect sizes of an intervention using standard deviation units (Pallant, 2013). In this study, Cohen's d ranged from 2.89 in the 3rd grade to 0.09 at the 8th grade. The gains were statistically significant ($p < .05$) at the elementary school level. The 2nd- and 3rd-grade students whose teachers participated in the BCMSSI had the highest mean science NCE. They also had the highest percentage of students scoring at or above the 50th NPR. Their teachers registered the largest science content knowledge gains on pre-post BCMSSI tests that were aligned to the TEKS. These gains may have been the pivotal factor in the program impact.

A higher proportion of fifth through eighth-grade students whose teachers completed the full PD hours performed at or above the 50th NPR on the Iowa Assessment science tests compared to students whose teachers did not complete the full PD hours. Similarly, a higher proportion of 5th and 8th grade students whose teachers completed the full PD hours met Satisfactory at the Level II phase-in 1 and Advanced performance standard of the 2015 STAAR science tests.

The treatment effect of the full 60 PD hours on the 5th-grade science test was small (17 scales core points) and not statistically significant ($p = .524$). The treatment effect of the full 30 PD hours on 8th-grade science performance was large (253 scale score points) and statistically significant ($p < .0001$). Based on these findings, 422 (18%) additional 8th-grade students might have met Satisfactory at the Level II phase-in 1 standard on the 2015 STAAR science test had their teachers completed the full 60 BCMSSI PD hours. This demonstrates the effectiveness of the BCMSSI at the 8th-grade level. This result is critical because 8th grade marks the end of middle school and the transition to high school. More may have to be done to increase teacher completion of PD and the cost-effectiveness of the program since the service provider is contracted. Teachers are already being compensated, financially, for participation in the program.

Greater effort needs to be made to promote teacher commitment to program completion once enrolled. Compensation may have to be tied to completion rather than participation. Continued instructional focus should be directed towards at-risk and economically-disadvantaged students.

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Appendix A

Table 7. 2015 STAAR Mean Science Scale Score and Percent Who Met Standards, BCMSSI Fifth Grade

*5th Grade (n = 2561)	Mean Scale Score	Std. Dev.	Level II: Satisfactory Phase-in 1 Standard (%)	Advanced Performance Standard (%)
1–48.9 PD hours	3615	504	58.1	5.4
49–59.9 PD hours	3557	564	55.3	6.6
60 PD hours	3711	554	67.1	9.9

Note: *5th grade – "Satisfactory" Scale Score range : 3500–4304; "Advanced" Scale Score : 4402–5613 (Texas Education Agency, 2015)

Table 8. 2015 STAAR Mean Science Scale Score and Percent Who Met Standards, BCMSSI Eighth Grade

*8th Grade (n = 2361)	Mean Scale Score	Std. Dev.	Level II: Satisfactory Phase-in 1 Standard (%)	Advanced Performance Standard (%)
18–29 PD hrs.	3390	749	45.6	5.0
30 PD hrs.	3659	998	64.8	17.7

Note: *8th grade – "Satisfactory" Scale Score range : 3500–4345; "Advanced" Scale Score: 4406–6180 (Texas Education Agency, 2015)

Table 9. Treatment effect of 2014 BCMSSI PD Hours on 2105 8th-Grade STAAR Science Performance

Science Scale Score	Coefficient	Robust Std. Error	z	p > z	[95% Confidence Interval]	
Average Treatment Effect (ATE) [1]Summer PD Hours (2 vs. 1)	252.9	54.4	4.7	0.000*	146.3	359.5
Potential Outcome Mean [1]Summer PD hours 1	3364.8	50.1	67.2	0.000*	3266.7	3462.9

*p < .0001 Note: [1]1 = 18 - 29 PD hours; 2 = 30 PD hours

Table 10. Treatment effect of 2014 BCMSSI PD Hours on 2015 5th-Grade STAAR Science Performance

Science Scale Score	Coefficient	Robust Std. Err	z	p>z	[95% Confidence Interval]	
Average Treatment Effect (ATE) [1]Summer hours (2 vs. 1)	16.5	25.9	0.64	0.524	-34.2	67.3
Potential Outcome mean [1]Summer Hours 1	3589.0	21.2	169.5	.000*	3547.5	3630.5

*p < .0001 Note: [1]1 = 1-59.9 PD hours; 2 = 60 PD hours

Table 11. Linear Regression Model of Iowa Assessments Science NCE (1st to 4th Grades), 2015

Variable	2015 Iowa Assessment 1st Grade Science NCEs		2015 Iowa Assessment 2nd Grade Science NCEs		2015 Iowa Assessment 3rd Grade Science NCEs		2015 Iowa Assessment 4th Grade Science NCEs	
	***n* = 815**	***R²*= 30.0%**	***n* = 781**	***R²* = 30.6%**	***n* = 1,037**	***R²* =35.8%**	***n* = 1,042**	***R²* = 30.3%**
	β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Economically Disadv.	-.220	.000*	-.19.1	.000*	-.121	.000*	-.110	.000*
Summer PD	-.058	.500	-.112	.000*	.005	.848	-.012	.585
At risk status	-.282	.000*	-.272	.000*	-.361	.000*	-.338	.000*
G/T	.243	.000*	.271	.00*0	.305	.000*	.301	.000*

Note: *p <.0001

Table 12. Linear Regression Model of Iowa Assessments Science NCE (5th to 8th Grades), 2015

Variable	2015 Iowa Assessment 5th Grade Science NCEs		2015 Iowa Assessment 6th Grade Science NCEs		2015 Iowa Assessment 7th Grade Science NCEs		2015 Iowa Assessment 8th Grade Science NCEs	
	***n* = 2,535**	***R²*= 49.1%**	***n* = 2,501**	***R²*= 52.3%**	***n*= 3,223**	***R²* = 52.3%**	***n* = 2,288**	***R²* = 48.3%**
	β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Economically Disadv.	-.149	.000*	-.100	.000*	-.101	000*	-.101	.000*
Summer PD	.019	.224	.112	.000*	.067	000*	.072	.000*
At risk status	-.394	.000*	-.421	.000*	-.441	.000*	-.377	.000*
G/T	.264	.000*	..304	.000*	.335	.000*	.343	.000*

Note: *p<.0001